

The opinion in support of the decision being entered today (1) was not written for publication in a law journal and (2) is not binding precedent of the Board.

Paper No. 14

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte MEHRDAD M. MOSLEHI

Appeal No. 1997-3691
Application No. 08/298,018

ON BRIEF

Before FLEMING, HECKER, and LEVY, *Administrative Patent Judges*.

LEVY, *Administrative Patent Judge*.

DECISION ON APPEAL

This is a decision on appeal from the examiner's final rejection¹ of claims 6 and 10-13, which are all of the claims pending in this application.

BACKGROUND

¹ An amendment (Paper No. 6, filed April 1, 1996) filed subsequent to the final rejection (Paper No. 5, mailed January 16, 1996) was entered by the examiner as indicated in a subsequent advisory action (Paper No. 7, mailed April 26, 1996).

The appellant's invention relates to a method of fabricating a semiconductor device having a self-aligned silicide region. Specifically, as disclosed on page 9, lines 21- 27 of the specification "the self-aligned silicide regions can be performed [sic: formed] either before or after removal of the disposable silicon nitride layer 58. . . [T]he result of forming the silicided regions after the removal of silicon nitride layer 58 is depicted in figure 4a. The main difference . . . is the presence of silicided region 41 on conductive gate structure 40." An understanding of the invention can be derived from a reading of exemplary claim 6, which is reproduced as follows:

6. A method of fabricating a semiconductor device with a self-aligned silicide region, said method comprising:

providing a semiconductor substrate of a first conductivity type, said semiconductor substrate has a surface;

forming field insulating regions at said surface of said semiconductor substrate;

forming a gate structure insulatively disposed over said substrate and between said field insulating regions, said gate structure having a top surface and a side surface and including a gate electrode;

forming a disposable structure overlying said gate structure, said disposable structure having a top surface and a side surface;

forming side wall insulators adjacent to said gate structure and said disposable structure and extending along side surfaces of said gate structure and said disposable structure;

forming source/drain junction regions of a second conductivity type opposite said first conductivity type, said source/drain junction regions formed in said substrate adjacent to said gate structure and extending from said gate structure to said field insulating regions;

providing a channel region disposed between said source/drain junction regions beneath said gate structure in said substrate;

selectively removing said disposable structure;

providing a silicide region formed after said disposable layer is removed thereby forming said silicide layer on said gate structure and on said source/drain junction regions, said silicide formed by depositing a layer of metal, performing a react process and removing any unreacted metal and metal composites;

forming separate electrically conductive regions by means of a nonselective conductive material layer deposition process, each contacting one of said source/drain junction regions, and simultaneously forming an electrically conductive region from the same conductive material on said silicide region formed on said gate structure;

and wherein said silicide region formed on said gate structure is formed between said gate structure and said conductive region, and said conductive region formed on said silicide region formed on said gate structure is located in substantially the same location as the disposable structure with substantially the same thickness as the disposable structure.

The prior art references of record relied upon by the examiner in rejecting the appealed claims are:

Rodder	4,877,755	Oct. 31, 1989
Osinski (et al.)	4,885,259	Dec. 05, 1989
Thomas	4,920,071	Apr. 24, 1990
Feist	4,933,295	Jun. 12, 1990
Jin	5,070,038	Dec. 03, 1991
Huang (et al.)	5,130,266	Jul. 14, 1992
Sitaram (et al.)	5,352,631	Oct. 04, 1994

(filed Dec. 16, 1992)

Claims 6 and 10-13 stand finally rejected as follows:

Claims 6 and 10-11 stand rejected under 35 U.S.C. § 103 as being unpatentable over Feist in view of Rodder or Sitaram and Osinski. Claim 12 stands rejected under 35 U.S.C. § 103 as being unpatentable over Feist in view of Rodder or Sitaram and Osinski, and further in view of Jin and Thomas. Claim 13 stands rejected under 35 U.S.C. § 103 as being unpatentable over Feist in view of Rodder or Sitaram, Osinski, Jin and Thomas, and further in view of Huang².

Appellant states (brief, page 4) that “[c]laims 6 and 10-13 stand or fall together” not withstanding the separate grounds of rejection that pertain to dependent claims 12 and 13. We note that appellant only presents arguments directed towards claim 6, the sole independent claim before us on appeal. Accordingly, the claims will be considered to stand or fall with claim 6, *See* 37 CFR § 1.192 (c) (7) and (c) (8) (iv) (1996).

Rather than reiterate the conflicting viewpoints advanced by the examiner and the appellant regarding the above-noted rejections, we make reference to the examiner's answer (Paper No. 13, mailed March 4, 1997) for the examiner's reasoning in support of the rejections, and to the appellant's brief (Paper No. 12, filed September 21, 1996) for the appellant's arguments thereagainst.

² Appellant lists (brief, page 4) the issues on appeal as including whether claims 6 and 10-13 are definite as defined under 35 U.S.C. § 112, second paragraph. A rejection of claims 6 and 10-13 under 35 U.S.C. § 112 (2) as indefinite is not found in the examiner's answer. We note, however, that the rejection was set forth in the final rejection (Paper No. 5, filed January 16, 1996), and was modified by the examiner in the advisory action (Paper No. 6, filed April 1, 1996) that was sent out in response to the amendment (Paper No. 7, filed April 26, 1996) filed subsequent to the final rejection. The rejection of claims 6 and 10-13 under 35 U.S.C. § 112 (2) has been briefly argued by the examiner (answer, page 9). However, since the rejection of claims 6 and 10-13 has not been set forth in the “Grounds of Rejection” found in the examiner's answer, the rejection is considered to have been withdrawn by the examiner, and not before us for decision on appeal.

OPINION

In reaching our decision in this appeal, we have given careful consideration to the appellant's specification and claims, to the applied prior art references, and to the respective positions articulated by the appellant and the examiner. As a consequence of our review, we make the determinations which follow.

Appellant asserts (brief, page 6) that the examiner has improperly combined references which teach away from each other in an obviousness rejection. The examiner asserts (answer, page 6) that it would have been obvious to have “modified Feist by employing the disposable structure . . . because such would enable the formation of silicide regions separately if desired and because such disposable structure would advantageously serve to pattern the gate and to reduce the risk of short circuit.”

Appellant takes the position (brief, page 6) that Feist teaches simultaneously forming silicide regions on the gate structure and the source/drain regions, whereas both Rodder and Sitaram specifically teach to the contrary by using their disposable structures to prevent this from occurring. We find that in Feist, (figure 8, and col. 9, lines 50-68) metal silicide contacts (36), (38), and (40) are formed respectively on the inactive base (26'), emitter (30), and collector (32) at the same time. In contrast, Rodder utilizes a disposable structure (28) over the gate (30) in order to prevent a silicide region from being formed over the source/drain regions and the gate at the same time. Rodder specifically teaches (col. 1, lines 60-64, and col. 6, lines 1-16) providing a thicker silicide layer over the gate in order to decrease the

sheet resistance of the gate without increasing the junction depth of source/drain regions (42). Similarly, we find that Sitaram utilizes a disposable structure (20) over the gate to prevent (col. 4, lines 41-43) the gate (18) from being silicided (figure 3) at the same time as the areas (26) over the source/drain.

Sitaram teaches (col. 5, lines 46-53) that “[i]t is important to note that the silicided regions 26 and the silicided region 30 are formed via different metal materials” because

“[a]s stated previously, there are disadvantages to forming all of the electrodes (i.e. gate, source, and drain) with a single type of silicide region. . . . for example . . . cobalt silicide is not an optimum gate electrode silicide but is a good silicide region for both sources and drains when compared to other silicides.” (col. 5, lines 55-68)

As to the specific question of "teaching away," our reviewing court in *In re Gurley*, 27 F.3d 551, 553, 31 USPQ2d 1130, 1131 (Fed. Cir. 1994) stated:

[a] reference may be said to teach away when a person of ordinary skill, upon [examining] the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.

We are in agreement with appellant (brief, page 6) that both Rodder and Sitaram use their disposable structures to prevent simultaneously forming silicide regions on both the gate structure and the source/drain regions in order to have silicide regions of different thickness or materials. We therefore find that one of ordinary skill in the art would have been taught away from providing Feist with a disposable structure in view of Feist's disclosure of forming the silicide layers over the gate structure and the source/drain regions at the same time.

We are in agreement with the examiner (answer, page 6) that Osinski suggests providing Feist with a disposable structure. However, even if Feist were provided with a removable structure as advanced by the examiner, we find that the limitations of claim 6 would still not be met.

Osinski discloses (col. 1, lines 50-63) that

[i]t has been found that the use of an etching mask of photoresist in practice leads to a number of disadvantages. During the step of etching the comparatively thick layer of polycrystalline silicon, the photoresist can be attacked, as a result of which the gate electrode formed obtains side edges which are arranged obliquely to the surface. Consequently, it is difficult to provide the gate electrode with suitable edge isolation parts, as a result of which during the formation of metal silicide there is the risk that the source and drain zones are electrically connected to the gate electrode. Moreover, the use of photoresist for the etching mask has the disadvantage that polymeric residues are left on the surface, which can be removed only with difficulty.”

In Osinski (col. 3, lines 40-68), a disposable structure (silicon nitride mask) (10) is used as a mask in the forming of the gate electrode (11) to provide an electrode with practically straight edges (12) which provides for sidewall insulators (edge isolation parts) (20) “in a simple manner on the gate electrode 11 so that during the formation of metal silicide the risk of shortcircuits [sic] is very small.” After the formation of the source and drains (17) and (18) respectively, the disposable structure (10) is removed prior to the formation of the silicide regions (27) (col. 4, lines 31-57), with the silicide regions being formed at the same time. We find that while Feist forms the silicide regions (figure 8) at the same time, Feist utilizes a photoresist layer (not shown) (figures 3 and 4, and col.6, lines 42-57) to pattern, *inter*

alia, the emitter region (30). In view of the teachings of Osinski, while we conclude that one of ordinary skill in the art would have been taught to modify Feist to provide a disposable structure in order to provide better patterning of the gate, simplified formation of the sidewall insulators (20), and to reduce the chance of short circuit during the formation of the silicide regions, we find that even with such a modification, the language of the claim would not be met. Claim 6 requires the step of forming a gate structure, and then forming a disposable structure over the gate structure. Even if we provide Feist with a disposable structure as taught by Osinski to pattern the gate, as advanced by the examiner (answer, page 6), the claim language would not be met because the disposable structure would be formed prior to the gate in order to pattern the gate which is the opposite of what the claim requires. Moreover, claim 6 further requires

said conductive region formed on said silicide region formed on said gate structure is located in substantially the same location as the disposable structure with substantially the same thickness as the disposable structure.

Appellant asserts (brief, page 7) that none of the references teach this limitation because the region where the conductive layer is formed on the silicide region formed on the gate is either unbounded or the process utilized to form the conductive structure is such that the thickness of the conductive structure would not be the same as that of the disposable structure. We agree. We are not persuaded by the examiners assertion (answer, page 7) is that “such limitation is deemed to have been obvious over the applied prior art” because (answer, page 6) “[i]t would have been obvious and would have

been within the purview of one skilled in the art to select and optimize the appropriate parameters and dimensions including the thickness of the conductive region to obtain the desired conductivity.”

The examiner’s unsupported statement is insufficient to meet the examiner’s burden of producing a factual basis for the rejection. Nor do we find, from our review, any teaching in the prior art references to Feist, Osinski, Rodder or Sitaram that would have suggested a conductive region formed on said silicide region which is formed on said gate structure located in substantially the same location as the disposable structure with substantially the same thickness as the disposable structure. We are not inclined to dispense with proof by evidence when the proposition at issue is not supported by a teaching in a prior art reference or shown to be common knowledge of unquestionable demonstration. Our reviewing court requires this evidence in order to establish a *prima facie* case. *In re Piasecki*, 745 F.2d 1468, 1471-72, 223 USPQ 785, 787-88 (Fed. Cir. 1984); *In re Knapp-Monarch Co.*, 296 F.2d 230, 232, 132 USPQ 6, 8 (CCPA 1961); *In re Cofer*, 354 F.2d 664, 668, 148 USPQ 268, 271-72 (CCPA 1966). Our reviewing court states in *In re Piasecki*, 745 F.2d 1468, 1472, 223 USPQ 785, 788 (Fed. Cir. 1984) the following:

The Supreme Court in *Graham v. John Deere Co.*, 383 U.S. 1, 86 S.Ct. 684, 15 L.Ed.2d 545, 148 USPQ 459 (1966), focused on the procedural and evidentiary processes in reaching a conclusion under Section 103. As adapted to ex parte procedure, Graham is interpreted as continuing to place the "burden of proof on the Patent Office which requires it to produce the factual basis for its rejection of an application under sections 102 and 103." *In re Warner*, 379 F.2d 1011, 1020, 154 USPQ 173, 177 (CCPA 1967).

Accordingly, the rejection of claim 6 under 35 U.S.C. § 103 is reversed. As claims 10 and 11 depend from claim 6, the rejection of claims 10 and 11 under 35 U.S.C. § 103 is reversed. As claim 12 depends from claim 6 and the references to Jin and Thomas, additionally relied upon by the examiner, do not overcome the deficiencies of Feist, Osinski, Rodder and Sitaram, the rejection of claim 12 under 35 U.S.C. § 103 is reversed. As claim 13 depends from claim 12 and the reference to Huang, additionally relied upon by the examiner, does not overcome the deficiencies of Feist, Osinski, Rodder, Sitaram, Jin and Thomas, the rejection of claim 13 under 35 U.S.C. § 103 is reversed.

CONCLUSION

To summarize, the decision of the examiner to reject claims 6 and 10-13 under 35 U.S.C. § 103 is reversed

REVERSED

MICHAEL R. FLEMING)	
Administrative Patent Judge)	
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)	BOARD OF PATENT
STUART N. HECKER)	APPEALS
Administrative Patent Judge)	AND
)	INTERFERENCES
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